MIT International Center for Air Transportation

Interactive Electronic Flight Strips

Nathan A. Doble

R. John Hansman

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Motivation

- **Controller interface needed for MIT departure planner**
- **System architecture and design driven by requirements analysis**
  - Functional (controller input-output)
  - Human factors

DP Interface
Functional Requirements

- **Controller Input**
  - Aircraft “ready to push” time
  - Aircraft push time
  - Aircraft taxi start time
  - Aircraft takeoff time
  - Aircraft gate location
  - Current runway configuration
  - Downstream constraints
- **Controller Output**
  - Suggested runway configuration changes (configuration manager)
  - Pushback queue and initial runway assignments (gate manager)
  - Virtual runway queue and takeoff times (virtual queue and mix managers)
- **All other DP input from static databases (e.g., airport layout) or other sources (e.g., weather forecasts, airline schedules)**

DP Interface
Human Factors Requirements

- **Head-up operation**
- **Mobility within tower cab**

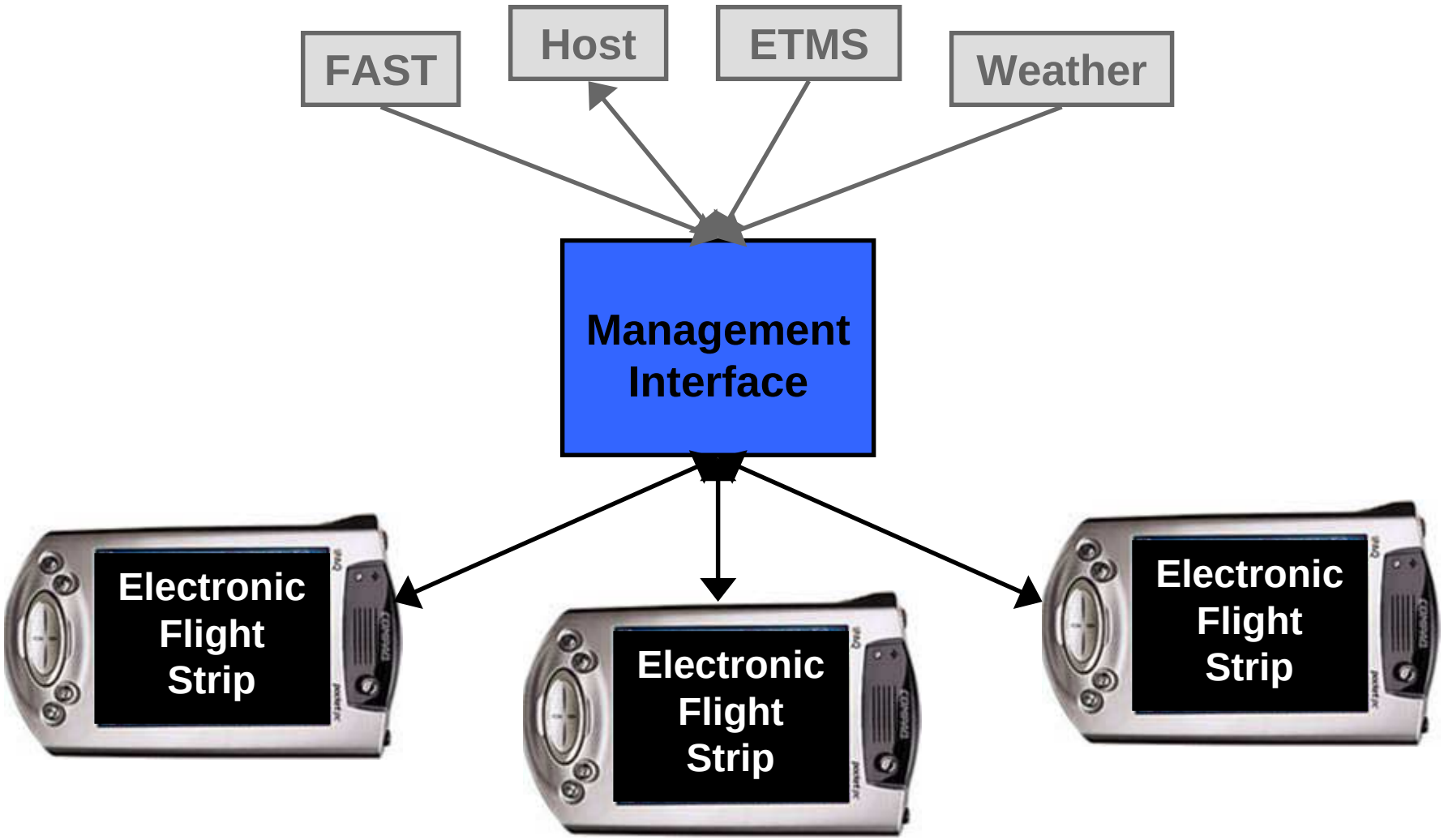
Observations

- **Some DP inputs already written on paper flight strips**
  - “Ready to push” time
  - Actual push time
  - Takeoff time
- **Some aircraft-specific DP inputs would be easy to add to a flight strip**
  - Taxi start time
  - Gate location
- **Other DP inputs and outputs better suited to centralized interface**
  - Current runway configuration
  - Suggested runway configuration changes
  - Downstream restrictions
  - Runway, Taxi, and Push queues

System Architecture Conclusions

- **To satisfy all interface functional requirements**
  - Electronic flight strip system
  - Central management interface
- **To satisfy human factors requirements of tower environment**
  - An electronic analogue of the individual paper flight progress strip, not just an electronic analogue of the strip rack
- **Solution: PDA-based electronic flight strips communicating over wireless LAN with desktop-based central management interface**

System Architecture



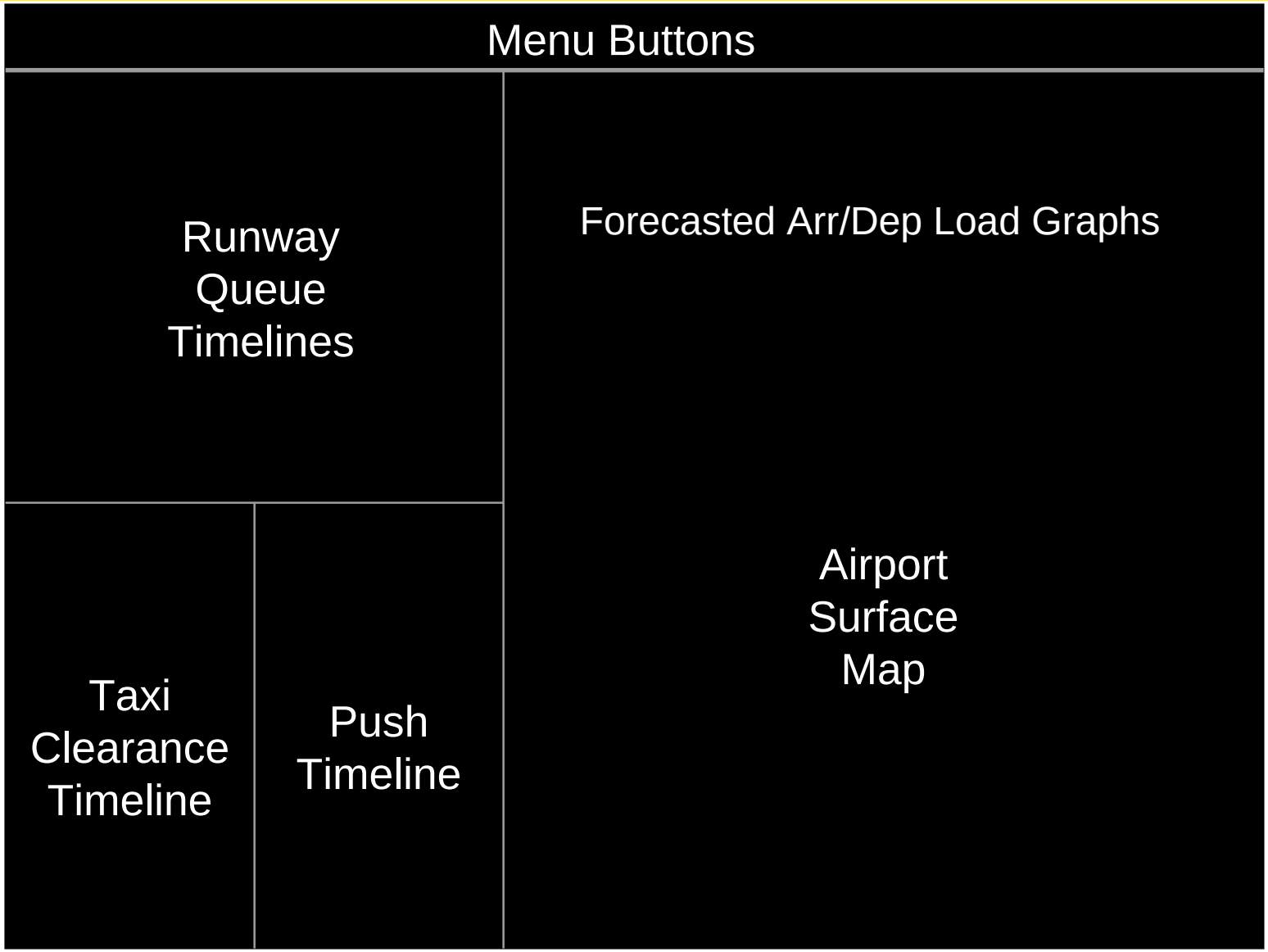
Design Considerations

- **Electronic flight strip must preserve functionality present in current paper departure flight strips (source: BOS Tower SOP)**
  - Changing aircraft type, altitude, route, etc.
  - Recording initial heading
  - Recording ready to push and departure times
  - Recording in-trail restrictions
  - Recording nonstandard taxi paths
  - Indicating wake turbulence waiver
  - Indicating ATIS received by aircraft
  - Indicating position and hold clearance issued
  - Writing any other nonstandard instructions
- **Other aspects of paper flight strips and strip rack that should be preserved**
  - Natural input method (handwriting)
  - Handoffs completed by physically transferring strip from controller to controller
  - Ability to sort flights in strip rack

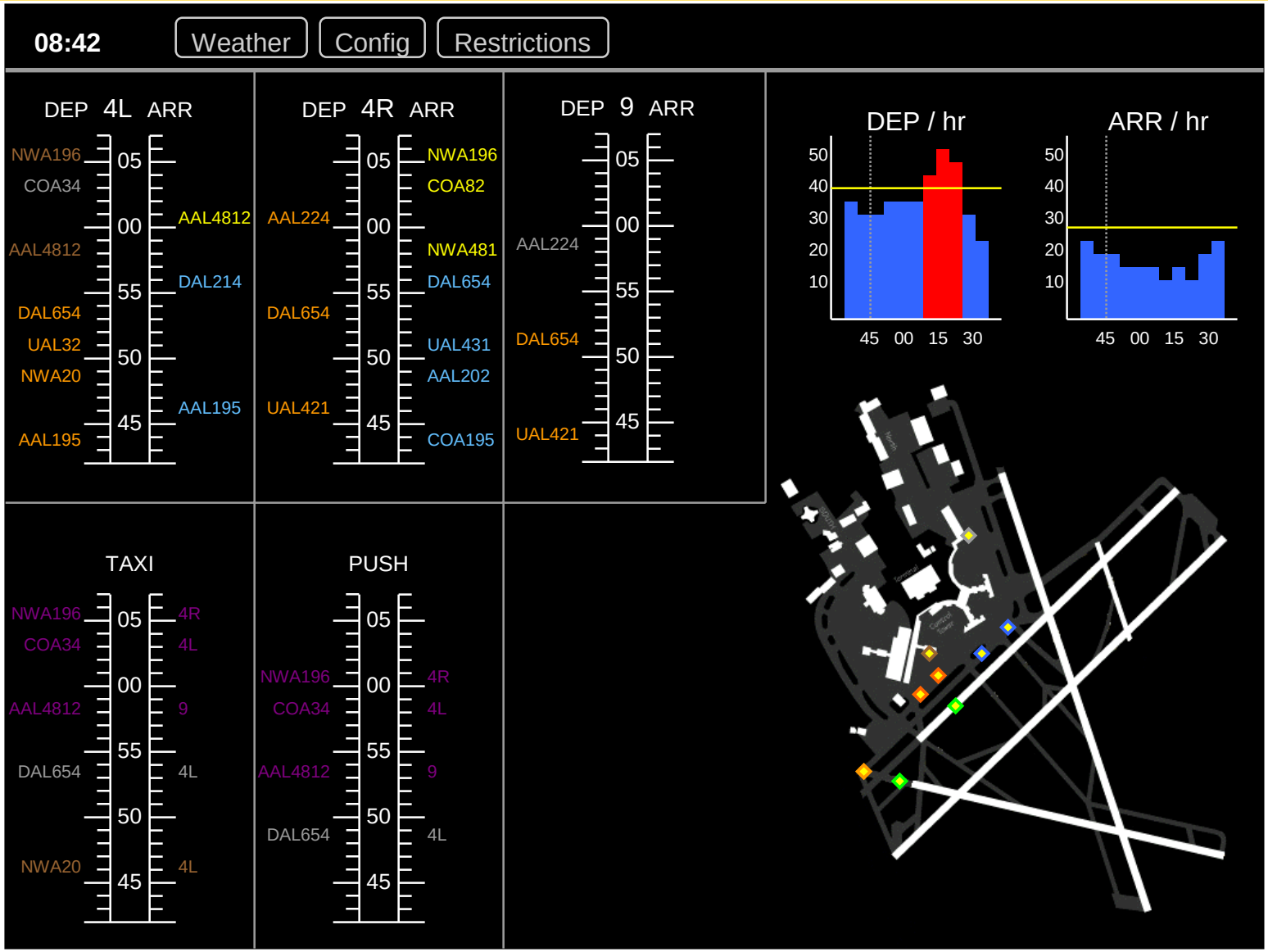
Design Considerations (2)

- **Although not required by DP or current flight strip procedures, electronic interface would allow additional features**
  - Customized views for each controller position
  - Airport surface map
    - Aircraft positions
    - Taxi clearances
    - Runway assignments
  - Runway incursion alerting
  - Weather information
  - Performance metrics
  - Trial planning for virtual runway queue

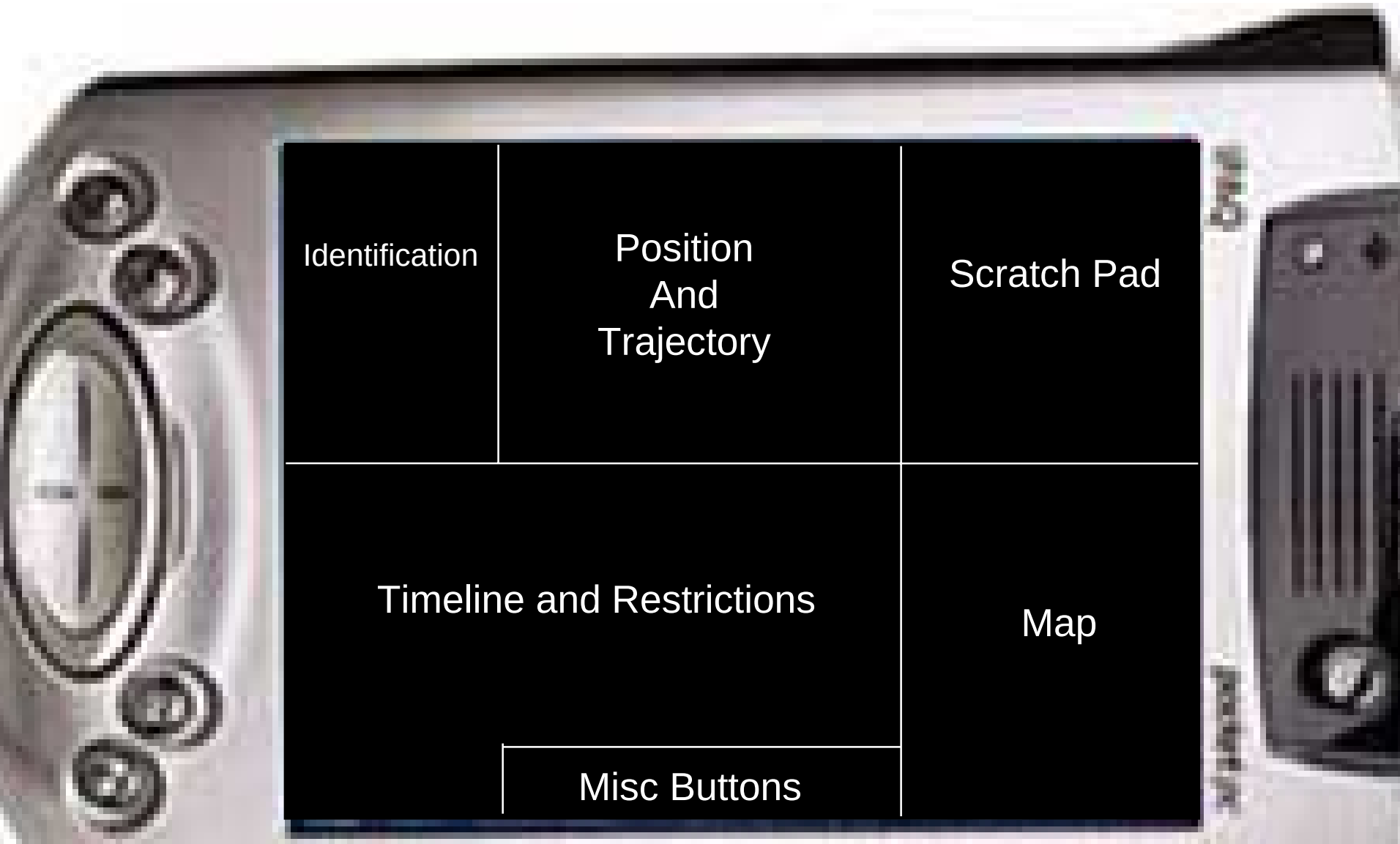
Management Interface: General Layout



Management Interface



Flight Strip: General Layout



Flight Strip: Clearance Delivery

Flight Strip: Push / Ramp Control

Flight Strip: Ground Control

Flight Strip: Local Control

Issues

- **Absolute vs. differential time**
- **Color conventions**
  - If runway incursion information included, possible conflicts between standard aviation display color coding and paper flight strip coloring, timeline color-coding
- **Flight strip position determination**
  - In order to perform automated handoffs or automated sorting with the strip rack, some position information must be known
  - Instrumenting the strip vs. instrumenting the strip rack
    - Prigge & How: Dipole magnetic fields to track (x,y,z) position of flight strip, centimeter accuracy shown
    - Mackay: Resistors on flight strips to determine position on strip rack

Current Progress

- **PDA and wireless LAN hardware purchased**
- **Test application running on PDAs**
  - ☐ Runs full-screen
  - ☐ Basic line drawing and text printing (portrait only) functions
  - ☐ Accepts stylus input
  - ☐ Controls hardware buttons
  - ☐ Sends and receives messages via wireless LAN
  - ☐ Handwriting recognition not yet enabled

Future Work

- Finish coding initial design of flight strips and management interface
- Solicit input on interface from Boston Logan controllers
- Revise design based on controller input
- Evaluate controller performance with electronic flight strips